

Sample Space, Union, Intersection, Complements, Venn Diagrams

Sample Space: The set of all possible outcomes for a chance process.

Event/Subset: An outcome or set of outcomes from the sample space.

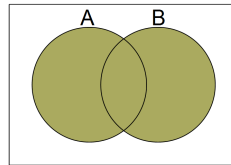
Complement (A^c): “Not”

- All outcomes in the sample space that are not part of the event.

Chance Process	Sample Space	Event/Subset	Complement
Flip a coin	$S = \{\text{heads, tails}\}$	$B = \{\text{heads}\}$	$B^c = \{\text{tails}\}$
Roll a die	$S = \{1, 2, 3, 4, 5, 6\}$	even numbers $E = \{2, 4, 6\}$	$E^c = \{1, 3, 5\}$
Pick a letter in the word “probability”	$S = \{P, R, O, B, A, I, L, T, Y\}$	vowels $V = \{O, A, I, Y\}$	$V^c = \{P, R, B, L, T\}$

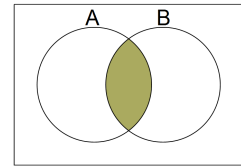
Union ($A \cup B$): “Or”, “Either”

- All of the elements that are in A or B or both.

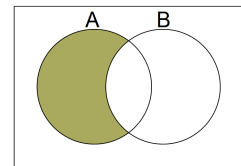


Intersection ($A \cap B$): “And”, “Both”, “Overlap”, “In common”

- All of the elements that are in *both* A and B .
- If the two sets don't have anything in common, the intersection is the “empty set”, indicated by \emptyset or $\{ \}$.

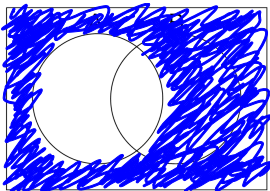


Note: If you want to write “everything in A that isn't in B ,” you can write either $A \cap B^c$ or $A - B$.

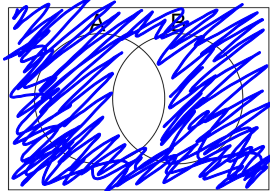


Examples: Shade the appropriate portion of the Venn diagram.

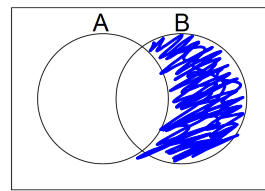
1. A^c ← not in A



2. $(A \cap B)^c$ ← not in both



3. $B - A$ ← in B , but not in A



Examples:

- Chance Process: Rolling a 10-sided die.
 - Event A: Rolling an odd number
 - Event B: Rolling a prime number

a. What is the sample space?

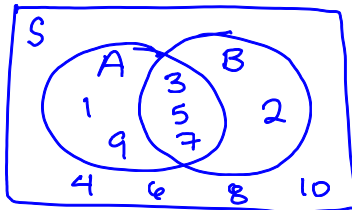
$$S = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$$

b. List the outcomes in each event.

(odd) $A = \{1, 3, 5, 7, 9\}$

(prime) $B = \{2, 3, 5, 7\}$

c. Draw a Venn diagram representing the sample space with subsets A and B.



d. List all the outcomes in $A \cup B$. All the numbers that are odd or prime (or both)

$$\{1, 3, 5, 7, 9, 2\}$$



e. List all the outcomes in $A \cap B$. All the numbers that are both odd and prime

$$\{3, 5, 7\}$$



f. List all the outcomes in A^c . All the numbers that are not odd

$$\{2, 4, 6, 8, 10\}$$



g. List all the outcomes in $(A \cup B)^c$. All the numbers that are not either odd or prime

$$\{4, 6, 8, 10\}$$



h. List all the outcomes in $A - B$. All the numbers that are odd, but not prime

$$\{1, 9\}$$



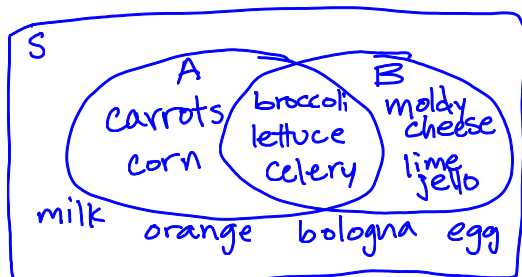
- Chance Process: Reaching into a messy refrigerator and grabbing a food at random.
- Sample Space: $S = \{\text{broccoli, carrots, moldy cheese, milk, orange, lettuce, lime jello, bologna, egg, corn, celery}\}$
 - Event A: Picking a vegetable
 - Event B: Picking something green

a. List the outcomes in each event.

(veggies) $A: \{\text{broccoli, carrots, lettuce, corn, celery}\}$

(green) $B: \{\text{broccoli, moldy cheese, lettuce, lime jello, celery}\}$

b. Draw a Venn diagram representing the sample space with subsets A and B.

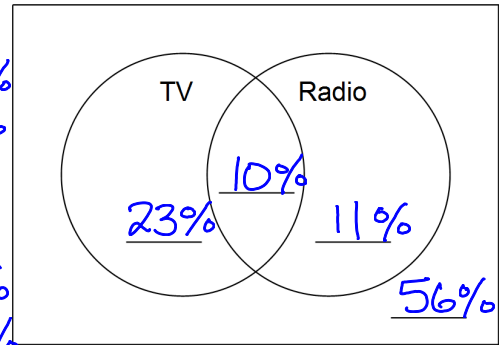


- c. List all the outcomes in $A \cup B$. *veggie or green*
 $\{broccoli, carrots, lettuce, corn, celery, moldy cheese, green jello\}$
- d. List all the outcomes in $A \cap B$. *veggie and green*
 $\{broccoli, lettuce, celery\}$
- e. List all the outcomes in B^c . *not green*
 $\{carrots, corn, milk, orange, bologna, egg\}$
- f. List all the outcomes in $(A \cap B)^c$. *not both veggie and green (not in the overlap)*
 $\{carrots, corn, milk, orange, bologna, egg, moldy cheese, lime jello\}$
- g. List all the outcomes in $B - A$. *green but not a veggie*
 $\{moldy cheese, lime jello\}$

Examples:

A political ad was run on TV and on radio.

- 33% of people saw it on TV. *TV circle adds to 33%*
- 21% heard it on the radio. *Radio circle adds to 21%*
- 10% of people both saw it on TV and heard it on the radio. *overlap is 10%*



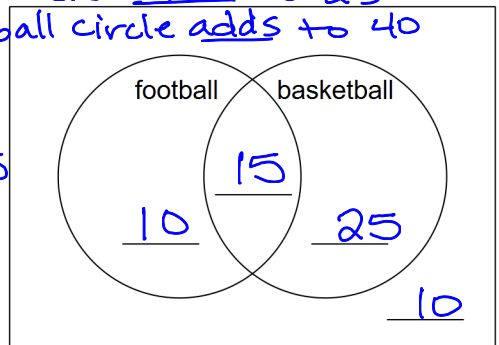
Determine what percent:

- a) only saw it *23%* $33\% - 10\% = 23\%$
- b) only heard it *11%* $21\% - 10\% = 11\%$
- c) neither heard it or saw it *56%*
- d) did not see it *11% + 56% = 67%*

$23\% + 10\% + 11\% = 44\%$
 $100\% - 44\% = 56\%$

A sample of 60 people are asked if they enjoy watching basketball and if they enjoy watching football.

- 25 people say they enjoy watching football - *football circle adds to 25*
- 40 people say they enjoy watching basketball - *basketball circle adds to 40*
- 15 people say they enjoy watching both - *overlap*



Determine how many people:

- a) enjoy football but not basketball *10* $25 - 15 = 10$
- b) enjoy basketball but not football *25* $40 - 15 = 25$
- c) don't enjoy either basketball or football *10*
- d) don't like football *25 + 10 = 35*

$10 + 15 + 25 = 50$
 $60 - 50 = 10$